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NODAWAY RIVER BRIDGE
Iowa Bridges Recording Project
Pilot Grove County Park (Moved from
Spanning Nodaway River S. of Grant, Iowa)
Grant Vicinity
Montgomery County
Iowa

HAER No. IA-68

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HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
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NODAWAY RIVER BRIDGE

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Location:	Walking path over small pond; Pilot Grove Park, 3.0 miles west of Grant, Montgomery County, Iowa (moved from original location) UTM: 15.328490.4556750 USGS: Griswold NE, Iowa quadrangle (7.5 minute series, 1978)
Date of Construction:	1876
Designer/Contractor:	Missouri Valley Bridge and Iron Company, Leavenworth, KS
Present Owner:	Montgomery County Conservation Board
Present Use:	Pedestrian bridge (formerly roadway bridge)
Significance:	The Nodaway River bridge is an example of what was once a common bridge form: the bowstring arch-truss. In the 1860s and 1870s bowstring arch-trusses were used extensively because of their great structural efficiency and relatively low construction costs. During this period many thousands of bowstring arch-trusses were built throughout the nation. Because the development of Iowa's road system coincided with this period, the number of bowstrings built in the state numbered in the hundreds. Most of these were built by the large Ohio bridge companies, such as the King Iron Bridge and Manufacturing Company, and the Massillon Bridge Company. The Nodaway River bridge is an excellent example of a bowstring arch-truss that was built by a smaller company: the Missouri Valley Bridge and Iron Company of Leavenworth, Kansas.
Historian:	Geoffrey H. Goldberg, engineer August, 1995
Project Information:	This document was prepared as part of the Iowa Historic Bridges Recording Project performed during the summer of

1995 by the Historic American Engineering Record (HAER). The project was sponsored by the Iowa Department of Transportation (IDOT). Preliminary research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, CO.

The period during which iron bowstring arch bridges proliferated in Iowa is an interesting episode in the history of bridges. Following the exceptional growth in Iowa's population in the wake of its admission to the Union in 1846, there was a need for a basic transportation infrastructure within the fledgling state. Now that Iowa's boundaries had been defined and the Native Americans had been displaced there was a plethora of land to be developed. State and local officials encouraged settlers to the new state. Settlers came from the eastern states and from Europe - Germany was the greatest supplier of these early immigrants, followed by Ireland, England, Scotland, and Scandinavia. They wrote home telling of the rich soil and readily available land, encouraging others to follow. During the 1850s Iowa's population more than tripled.[1]

The development of the state's agricultural industry was highly successful. By 1860 Iowa was the tenth largest producer of grain in the nation.[2] Major markets for Iowa's agricultural products were Chicago and the large eastern cities as well as the overseas markets of England, Scotland, and Ireland. This development could only be sustained if a sufficient transportation infrastructure were present. Where the transportation systems were most developed, hogs were raised. Where populations were less dense and transportation systems undeveloped, cattle were raised.[3]

The need to reach large out-of-state markets was met by the

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[1]Leland L. Sage, *History of Iowa,* Ames, IA: Iowa State University Press, 1974, p. 92. In 1850 the population was 192,214. By 1860 the population had risen dramatically to 674,913.

[2]William H. Thompson, *Transportation in Iowa: A Historical Summary*. Ames, IA: Iowa Department of Transportation, 1989, p.43. The major grains produced were(in order of decreasing significance): corn, wheat, oats, buckwheat, barley, and rye.

[3]Thompson, p.43.

development of the railroad system in the state. This coincided with out-of-state interests to have the key hub of Chicago linked with the Mississippi and Missouri rivers which define Iowa's eastern and western boundaries. In 1856 the United States Congress granted land to establish four railroads across the state. By 1866 rails had made it to Des Moines; one year later Council Bluffs on the Missouri River was reached.[4]

Although the railway system was vital to the economic development of the state, the intense concentration on the rail system did little to help development of the road systems. Roads were crude affairs. There was very little grading, and improvements were limited to filling in low spots to keep the roads above the water level during the rainy season.[5] Although little effort was put into developing road surfaces, the need to cross streams, rivers, and gullies was given great attention, leading to the need for a great number of bridges.

The responsibility for roads and bridges was for the most part strictly local. Initially townships, later the counties, took on the burden of developing and maintaining the roads. Typically, the cost of building a bridge would be funded by the county paying a large fraction (often 2/3) and the balance was paid by subscribers - that is, the adjacent landowners, merchants, and farmers who held a major stake in the bridge being built.

The principal rivers of Montgomery County that required spanning run north-south: the East Nishnabotna, which runs through the center of the county, and the West Nodaway, which runs through the east. The town of Grant (then called Milford)[6], is bordered on the East by the West Nodaway, and on the West by the Seven Mile Creek. The flood drainage system of the Nodaway, with its rich, dark loam, is considered among the finest agricultural land in the state.[7]

The early bridges were made of wood and had very limited life

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[4]Sage, p.112.

[5]Thompson, p.69.

[6]Montgomery County Supervisors' Minute Book 2, page 313 (10 January 1876) Montgomery County Courthouse, Red Oak IA. Because another town had the right to the name "Milford" the town's name was changed to Grant (after President U.S. Grant) in 1903.

[7]*History of Montgomery County, Iowa*. Des Moines: Iowa Historical and Biographical Co., 1881. p.113.

expectancy. By the time that Iowa was admitted to the Union iron bridge technology was reaching a critical mass. The birth of iron bridges occurred in Britain following the development of industrial processes for the smelting of iron. The first iron bridge was built by Abraham Darby III in 1779 in Coalbrookdale, England. This was a cast-iron arch design which exploited the compressive strength of cast iron. Cast iron presented the early bridge designers with a problem, however, because it offered very poor strength when loaded in tension. In 1783 Henry Cort patented a method for shaping wrought-iron sections using rollers.[8] The following year he patented the puddling process for the conversion of cast iron to wrought iron. For the first time, wrought iron, capable of accepting compression *and* tension, was available in sufficient quantities in convenient shapes.

The first iron bridge in the United States was built in 1836 by Captain Richard Delafield of the Army Corps of Engineers in Brownsville, Pennsylvania. A decade latter, at the time of the creation of the state of Iowa, the railroads were beginning to build iron trusses. In 1841 Squire Whipple, of upstate New York, received a patent for a bowstring arch-truss.[9] This design consisted of a cast-iron arch with a wrought-iron lower chord, as well as diagonals and vertical rods of wrought iron. Many of these bridges were built in New York state, particularly for crossing the Erie Canal. Whipple's bowstring inspired many copies. In 1857 Thomas Moseley patented a bowstring design which used arches that were "built up of wrought plate iron...to give the whole arch transversely the form and strength of an arch, and to admit of very long spans without excessive weight, presenting at once the combined features of extraordinary strength and lightness."[10] The idea of building-up the upper chord was the key. Other patents would follow - all using built-up sections of one type or another.

The bowstring arch was the preferred design because of its efficient use of material. These bridges were prefabricated in the shop, broken down into parts for shipping, and erected at the site. Moseley created the Moseley Bridge Company in Cincinnati and in 1861 one of his agents, Zenas King (along with

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[8]Emory L. Kemp, "The Introduction of Cast and Wrought Iron in Bridge Building," *IA: The Journal of the Society for Industrial Archaeology* 19,no.2(1993): 5-16 presents an excellent discussion of the early use of iron in bridge building.

[9]Letters Patent No. 2064, April 24, 1841.

[10]Letters Patent No. 16,572, February 3, 1857.

a metalworker Peter Frees) took out his own patent for a bowstring bridge.[11] The company King created - the King Iron Bridge and Manufacturing Company of Cleveland, became a powerhouse in the iron bridge building industry. During the 1860s and 1870s they built hundreds of bowstring bridges throughout the nation. Other large bridge companies got in the act, including David Hammond's Wrought Iron Bridge Company of Canton, Ohio; and Joseph Davenport's Massillon Bridge Company of Massillon, Ohio. During this brief period thousands of bowstring arch bridges were built, spanning rivers, streams and gullies throughout the nation.

As intense as the bowstring building activity was, the bloom was short lived. Although the bowstring form is efficient in its use of material, it did suffer from some major problems. Because the upper chord members were bent to take the shape of the arch, each span length required a unique curve. This was a distinct manufacturability problem. The competing Pratt design, patented in 1844 by Thomas and Caleb Pratt, had straight parallel upper and lower chords. Bridges of various spans could be accommodated by adding additional panels or simply selecting the appropriate element lengths, while the bowstring, with its fixed curved arch, could not. Probably, an even greater problem was the perception that the bridges were unsafe. The feelings of one Iowa state highway engineer from 1914 is indicative: "The bridges are light and flimsy. Everything about them is conducive to extreme and excessive vibration. Every man who has crossed one has noticed the trembling of the structure and the rattle of the rods and members of the bridge."[12]

The Nodaway River Bridge is a typical example of the bowstring design of the Missouri Valley Bridge Company, of Leavenworth, Kansas.[13] The company was founded by Edwin I. Farnsworth, who was among the early settlers of Leavenworth, where he served as the city engineer from 1867 until he left to become an agent for the Wrought Iron Bridge Company of Canton, Ohio in 1871. A year after he joined the Wrought Iron Bridge Company, he was appointed chief engineer for the King Iron Bridge Company at their Topeka, Kansas shop. His experience with these two great iron bridge firms exposed Farnsworth to the full range of the

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[11]Letters Patent No. 33,384, October 1, 1861.

[12]"Treacherous Danger in Bow String Bridge," *Iowa Highway Commission Service Bulletin*. August, 1914, p.7.

[13]Larry Jochims, Kansas State Historical Society. Letter to author. 9 June 1995. Much of the history of the Missouri Valley Bridge Company was taken from this source.

bridge building business, from marketing through design, and manufacturing. In 1874, Farnsworth returned to Leavenworth, to organize the Missouri Valley Bridge and Iron Works along with D.W. Eaves. Farnsworth left the company in 1878, when it was taken over by A.J. Tullock, an engineer from Rockford, Illinois, and the banking firm of Insley and Shire. Farnsworth later founded the Kansas City Bridge and Iron Company, the Chicago Bridge and Iron Company, along with Horace Horton[14], and the firm of Farnsworth and Blodgett.

In January, 1876, a farmer, S.M. Smith, and others, petitioned the Montgomery County supervisors for a bridge over the West Nodaway River, south of Grant. In June, the supervisors ordered the bridge's erection, along with others over the Nishnabotna and Seven Mile Creek.[15] After examining plans and offers the board awarded a contract for the Nodaway River Bridge to the Missouri Valley Bridge Company for $1,000.[16]

The 70' span Nodaway River Bridge is a pony truss bowstring arch. Because the bridge was built when the iron bowstrings were so popular, and given Farnsworth's familiarity with King's bowstring designs, it is not surprising that this bridge form was employed here. The bridge's upper chord is built-up from a pair of channels, with a cover plate forming the top surface and double lacing forming the lower surface. The lower chord is composed of a pair of rectangular bars, spliced at midspan, and threaded at the ends so they can be bolted to large cast-iron bearing shoes. These shoes also receive the ends of the upper chord. The verticals are of star iron, and the diagonals are of round rod. The floor beams are I-sections, U-bolted to the lower chords. Lateral stability was provided by star iron outriders which ran from the ends of lateral struts, extending beyond the vertical plane of the trusses, to the upper chords.

In 1968 the bridge was moved to its present location in Pilot Grove County Park in Montgomery County where it carries pedestrians over a finger of a small pond. The bridge stands as a fine example of a nineteenth-century iron bowstring bridge.

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[14]*The Bridge Works: A History of the Chicago Bridge and Iron Company*. Chicago: The Mobium Press, 1987 presents a detailed history of this fascinating company. The firm still exists.

[15]Supervisors' Minute Book 2, pages 330-31 (8 June 1876) They awarded the 100' iron bridge over the Nishnabotna River to the Canton Bridge Company of Canton, Ohio for $1,975.

[16]Supervisors' Minute Book 2, page 339 (14 July 1876)

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ADDENDUM TO
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This appendix is an addendum to a 7-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."